FLEXIBLE DUCT SLEEVE

Background of the Invention

1. Field of the Invention

The present invention relates generally to ductwork for heating, ventilating and air conditioning ("HVAC") systems, and in particular to a sleeve for protecting a length of flexible hose from crimping.

2. Description of the Prior Art

Hoses, ducts and conduits in various sizes and configurations are commonly utilized for conveying, routing and directing various substances and objects. In dynamic systems, examples of such substances include air which has been heated or cooled by heating and air conditioning equipment. In the construction industry such systems are commonly referred to as heating, ventilating and air conditioning (HVAC) systems.

Typical HVAC systems include runs of ductwork extending from the heating and air conditioning equipment to additional air handling equipment, or to distribution devices. Additional air handling equipment examples include variable air volume ("VAV") boxes which are located in plenum spaces in many commercial structures. Heated and cooled air is typically introduced into the occupied spaces of buildings by diffusers which direct the airflow in predetermined distribution patterns for maximizing the comfort of the occupants.

Routing ductwork from the air conditioning and heating equipment to the supply diffusers often involves ducting routes which turn, bend and intersect with various components and with other runs of ductwork. To accommodate such curved, angled, and bent routing, flexible duct is commonly used for the final portions of the duct runs, which terminate at diffusers or other components. Flexible duct also has the advantage of being easily reconfigurable to accommodate changed space configurations and the like. Another advantage of flexible duct is that it is available with insulation to avoid condensation during cooling operation.

However, a disadvantage of flexible duct is that it tends to crimp when bent (Figs. 5a, 6a and 7a). For example, 90° turns into diffusers can crimp unprotected flexible ducts. Crimping tends to restrict air flow and lower overall system efficiency. HVAC equipment thus works harder and consumes more power to overcome flow resistance associated with crimped flexible ducts.

A prior art solution to the problem of flexible duct crimping at diffusers and other bending locations is to install metal elbows, as shown in Fig. 7b. However, such additional components involve additional labor and material costs. Also, insulation may be required and further increase the installation costs.

The present invention addresses these disadvantages of prior art flexible duct installations. Heretofore there has not been available a sleeve for flexible duct with the advantages and features of the present invention.

Summary of the Invention

In the practice of the present invention, a sleeve assembly is provided for flexible ducts. The sleeve assembly includes a frame comprising first and second frame sections selectively secured together by fastener subassemblies. The frame includes first and second ends and a longitudinal axis extending therebetween. The sleeve assembly can subtend an appropriate angle for supporting a length of flexible duct through a corresponding bend. The frame includes multiple rings formed by ring halves each located in a respective frame section. Each frame section also includes multiple longitudinal members interconnecting respective ribs. The sleeve assembly is adapted for accommodating various applications and installations involving flexible duct, either straight or bent.

Objects and Advantages of the Invention

The principal objects and advantages of the invention include:

providing a sleeve assembly for flexible duct;

providing such a sleeve assembly which reduces crimping in flexible ducts;

providing such a sleeve assembly which enhances air distribution system efficiency;

providing such a sleeve assembly which can accommodate various flexible duct bend configurations;

providing such a sleeve assembly which can be fabricated from various materials;

providing such a sleeve assembly which can eliminate the need for metal elbows in air distribution systems;

providing such a sleeve assembly which can be manufactured from various components; and

providing such a sleeve assembly which is economical to manufacture, efficient in operation, capable of a long operating life and particularly well adapted for the proposed uses thereof.

Brief Description of the Drawings

Fig. 1 is a perspective view of a sleeve assembly for a flexible duct embodying the present invention.

Fig. 2 is an enlarged cross-sectional view thereof taken generally along line 2-2 in Fig. 1.

Fig. 3 is a perspective view of a coupling thereof.

Fig. 4 is an enlarged, cross-sectional view of an alternative construction thereof.

Fig. 5 is a side elevational view of a first installation of the sleeve assembly.

Fig. 5a is a side elevational view of a prior art configuration of the installation shown in Fig. 5.

Fig. 6 is a plan view of a second installation of the sleeve assembly.

Fib. 6a is a plan view of a prior art configuration of the installation shown in Fig. 6.

Fig. 7 is a side elevational view of a third installation of the sleeve assembly.

Fig. 7a is a side elevational view of a prior art configuration of the installation shown in Fig. 7, including a crimped flexible hose.

Fig. 7b is a side elevational view of a prior art configuration of the installation shown in Fig. 7, with a galvanized, sheet metal elbow transitioning from a length of flexible duct to a ceiling diffuser.

Fig. 8 is a side elevational view of an installation of the sleeve assembly at a 90° bend of a flexible duct, shown suspended from the underside of a floor slab.

Detailed Description of the Preferred Embodiments

I. Introduction and Environment

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which may be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure.

Referring to the drawings in more detail, the reference numeral 2 generally designates a sleeve assembly for a flexible member, such as a length of flexible duct 4. Without limitation on the generality of useful applications of the sleeve assembly 2, the flexible duct 4 received in same can comprise a portion of the ductwork in a heating,

ventilation and air conditioning ("HVAC") system in a building.

The sleeve assembly 2 generally comprises a skeletal frame 6 secured together by multiple fastener subassemblies 8.

II. Frame 6

The frame 6 comprises first (inner) and second (outer) frame sections 10a,b with an inner radius ("IR") arc 12a and an outer radius ("OR") arc 12b respectively. A longitudinal axis 14 extends between opposite ends 16 of the frame 6 in generally parallel relation to the radius arcs 12a,b. A passage 13 follows the longitudinal axis 14 and receives the flexible duct 4. The frame 6 includes a plurality of annular rings 18 each comprising a pair of ring halves or ribs 18a,b associated with a respective frame section 10a,b. As shown, the frame 6 extends through an arc of approximately 90° and includes four rings 18, two of which are located adjacent to the frame ends 16 and the remaining two of which are located intermediate same whereby the rings 18 are spaced at approximately 30° radial intervals forming gores 19 separated by respective adjacent rings 18.

The inner frame section 10a includes an inside radius longitudinal member 20a and a pair of side longitudinal members 20b which extend in generally parallel relation with respect to the longitudinal axis 14 and interconnect respective ribs 18a. The outer radius frame section 10b includes an outer radius longitudinal member 22a and a pair of side longitudinal members 22b. The rings 18 adjacent to the frame ends 16 include loops

24 mounted thereon in radially-spaced relation for receiving ties 26 which are adapted for securing the frame sections 10a,b together.

III. Fastener Subassembly 8

The frame sections 10a,b are secured together by the fastener subassemblies 8, each of which includes a pair of tabs 30 mounted on respective side edges 11a,b of the frame sections 10a,b. Each tab includes an inner leg 30a, a connector 30b and an outer leg 30c (Fig. 2). As shown in Fig. 2, the tabs 30 can be located at the connections between the ribs 18a and respective longitudinal members 20a,b and 22a,b. With the frame sections 10a,b placed together with their respective side edges 11a,b adjacent to each other, the tab connectors 30b are located adjacent to each other with the tab outer legs 30c projecting outwardly.

Each fastener subassembly 8 further includes a respective coupling 32 with a channel 34 receiving the tab outer legs 30c and a slot 36 receiving the tab connectors 30b. Each coupling 32 includes an extension 38 adapted to be grasped by an installer to facilitate mounting same. The sleeve assembly 2 described thus far can be fabricated of sheet metal stamped and folded into the desired configuration.

IV. Modified Embodiment Sleeve Assemblies

A sleeve assembly 102 comprising a first modified embodiment of the present invention is shown in Fig. 4 and can be molded from plastic or some other suitable material. The sleeve assembly 102 includes a modified fastener subassembly 108 with a first notched latch member 110a integrally formed with a respective first frame section ~~12a~~ 112b and a second notched latch member 110b integrally formed with a second frame section 112a ~~12b~~.

Still further, the sleeve assembly can have a generally tubular configuration which is fully enclosed throughout its entire length with a solid exterior open only at its ends. Such an enclosed or solid exterior configuration could be formed from molded plastic, stamped sheet metal, etc. Sleeve assemblies can be fabricated with various numbers of "gores" 19, which comprise the sections between respective rings. Thus, the frame 6 disclosed has three gores of approximately 30° each whereby the frame 6 subtends an angle of approximately 90° (30° x 3 = 90°). However, other angular configurations and other numbers of gores could be employed to meet the requirements of particular installations.

Moreover, various angles, radii and diameters can be utilized. The material comprising the frame can comprise, for example, plastic, fiber glass, sheet metal, wire, carbon fiber, etc.

Still further, sleeve assemblies can be constructed of multiple chains thereof

secured together. Thus, straight pieces could be combined with elbows, and various angular configurations could be assembled from smaller, angle components or elbows.

V. Installations

Fig. 5 shows a first installation or application of the sleeve assembly 2 in an HVAC system 52 including a supply duct 54 and a round tap 56 connected to same. The sleeve assembly 2 secures the end of a length of flexible duct 4 to the round tap 56 and supports same through a flexible duct bend 5a. The sleeve assembly 2 can be secured to the flexible duct 4 and the round tap 56 by any suitable means, including mounting screws 58 extending through receivers 60 formed in the rings 18 adjacent to the frame section ends 16. Ties 26 can also be utilized for providing annular constriction of the sleeve assembly 2 on the flexible duct 4 and the round tap 56. The flexible duct 4 extends from the sleeve assembly 2 to a diffuser 62 mounted in a ceiling 64.

A prior art configuration is shown in Fig. 5a and illustrates a potential restricted flow choke point 66, which is avoided by the use of a sleeve assembly 2.

Fig. 6 shows an installation of a modified, extended length sleeve assembly 202 connecting a length of flexible duct 4 to a variable air volume ("VAV") box 68. The extended length of the sleeve assembly 202 accommodates the operation of the VAV box 68 by providing a relatively straight length adjacent to the VAV box 68 inlet to enable its sensors to perform effectively pursuant to manufacturers' recommendations.

Fig. 6a shows a prior art configuration for connecting a length of flexible duct 4 to

a VAV box 68 whereby a choke point 66 can occur. Moreover, with the prior art configuration shown in 6a, the necessary uninterrupted straight run from the flexible duct 4 into the VAV box 68 is not accommodated.

Fig. 7 shows a sleeve assembly 2 coupling a length of flexible duct 4 directly to a diffuser 62. Prior art construction details for this configuration are shown in Figs. 7a and 7b. Fig 7a shows the potential choke point 66 which can form if no special consideration is given to maintaining the shape of the flexible duct 4 through a 90° turn as it enters a diffuser 62. Fig. 7b shows a prior art solution to this problem wherein a galvanized elbow 70 is connected to the flexible duct 4 and to the diffuser 62.

Fig. 8 shows another installation of the sleeve assembly 2 for supporting a length of flexible duct 4 at a bend 4a thereof located intermediate a supply duct 54 and a diffuser 62.